Spectral analysis of inter-channel scattering in the QH regime

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Experiments in quantum Hall (QH) systems on the charge transfer between co-propagating edge channels in the limit of high imbalance show the importance of the inner structure of the edge [1]. The inter-channel equilibration takes place along the whole length *d* over which the edges are in interaction. In all experiments performed to date the device geometry univocally fixes the value of *d*. We demonstrate for the first time how a scanning gate microscope (SGM) can be used to realize devices in which *d* is continuously tuned. This level of control is crucial to shed light on the microscopic details of edge-edge interaction. In the present work we focus in particular on the spectral analysis of the equilibration in the non-linear regime.

Devices included a 6 μm-long 1D channel with a gap of 1 μm. Measurements were performed at 300 mK and bulk filling factor ν=4 (two spin-degenerate edge channels). Inner and outer edge channels originate from two distinct voltage contacts at different potential. The two edge channels meet at the entrance of the 1D channel and travel in close proximity for a distance *d* [2] before they are separated by the action of the SGM tip [3]. For fixed values of the interaction lenght *d* we can measure the I-V characteristics of the inter-channel charge transfer. All curves show a linear behavior for small bias and a saturation at the full equilibration conductance for bias larger than a threshold voltage V_{th}. In previous works V_{th} was found to be a few mV smaller than the cyclotron gap [1]. The origin of this reduction is still under debate [1]. Here we follow both the change in zero-bias slope [2] and in V_{th} as a function of *d* on the *same* device. This evidences for the first time a monotonic reduction of V_{th} with increasing *d*. We will discuss these data on the basis of a simple model for the transfer of carriers between co-propagating edges, taking into account the influence of electron heating due to carrier injection between two highly imbalanced channels.

[1] A. Würtz *et al.*, Phys. Rev. B **65**, 075303 (2002); T. Nakajima *et al.*, Phys. Rev. B **81**, 085322 (2010); K. Ikushima *et al.*, Physica E. **42**, 1034 (2010).

[2] N. Paradiso, S. Heun *et al.*, Phys. Rev. B **83**, 155305 (2011).

[3] N. Paradiso, S. Heun *et al.*, Physica E. **42**, 1038 (2010).